Claims

1. A method for determining the amount of resolution (ADC_N) required for decoding a desired radio channel, comprising the steps of:

1) obtaining a target resolution (TARGET_N) for decoding the desired radio channel assuming that potentially interfering radio channels are filtered out;

2) measuring the received signal strength (RSSI) of the radio channel;

3) determining the amount of resolution (ADC_N) based upon the full-scale resolution (ADC_FULL) of an analog-to-digital converter, the target resolution and the received signal strength;

4) remeasuring RSSI;

5) determining if the new RSSI value is within certain threshold limits specified for that measurement; and

6) if step 5 is true, repeating steps 4 and 5; otherwise repeating steps 3, 4 and 5.

2. A method for determining the amount of resolution as defined in claim 1, wherein step 3 is defined by:

$$ADC\_N = ADC\_FULL - RSSI + TARGET\_N.$$

3. A method for determining the amount of resolution as defined in claim 2, wherein the determination of whether RSSI is within certain threshold limits specified for that measurement is performed by:

7) setting an RSSI target level (RSSI_TARGET) to the value of RSSI prior to the current measurement of RSSI;

8) measuring the current value of RSSI;

9) determining if RSSI_TARGET - (RSSI_TH) < RSSI < RSSI_TARGET + RSSI_TH is true;

9) if step 8 is true repeating steps 7 and 8; and

10) if step 8 is false, repeating steps 3, 6, 7 and 8;

wherein RSSI_TH is a threshold value used to determine the threshold limits; and wherein step 7 replaces step 4 and steps 9 and 10 replace step 5.

4. A method for determining the amount of resolution as defined in claim 2, further comprising the step of:

determining the gain (Apre_Av) that will provide a desired input level for the desired radio channel to be presented to the ADC.

5. A method for determining the amount of resolution as defined in claim 4, further comprising the step of:

measuring the signal level (ADC_OUT) at the output of the ADC;

and adjusting the value of the gain (Apre_Av)

if

a) ADC resolution is set to be at maximum or if ADC resolution remains within limits RSSI_TARGET - RSSI_TH < RSSI< RSSI_TARGET + RSSI_TH is true and if

b) ADC_OUT < ADC_HIGH is false or, if true, if

c) ADC_OUT > ADC_LOW is false;

where ADC_HIGH and ADC_LOW are the upper and lower signal threshold levels at the input of the ADC, respectively, that will indicate the need to change gain and where RSSI_TH is a threshold value used to determine the threshold limits.

6. A method for determining the amount of resolution as defined in claim 4, further comprising the steps of:

measuring the signal level (ADC_OUT) at the output of the ADC;

determining a fading margin (FADE_M) associated with the mode of operation of the desired radio channel; and

adjusting the value of the gain (Apre_Av)

if

a) ADC resolution is set to be at maximum or if ADC resolution remains within limits RSSI_TARGET - RSSI_TH < RSSI<

RSSI_TARGET + RSSI_TH is true and if

b) ADC_OUT < ADC_FULL - FADE_M is false or, if true, if

c) ADC_OUT > ADC_FULL - FADE_M - 2 *Apre_step is false;

where Apre_step is the gain step of an amplifier that is used to provide the gain (Apre_Av) to the radio channel prior to analog-to-digital conversion and where RSSI_TH is a threshold value used to determine the threshold limits.

7. A method for determining the amount of resolution as defined in claim 5, wherein the gain adjustment if substep a) is true and substep b) is false is:

Apre_Av(n) = Apre_Av(n-1) - Apre_step,

and wherein the gain adjustment if substeps a) and b) are true and substep c) is false is:

Apre_Av(n) = Apre_Av(n-1) + Apre_step;

where n is the sequence samples in time.

8. A method for determining the amount of resolution as defined in claim 3, wherein the step of measuring received signal strength (RSSI) is based upon an average value of the received signal strength.

9. A method for determining the amount of resolution as defined in claim 1, wherein the step of measuring received signal strength (RSSI) is based upon an average value of the received signal strength.

10. A method for determining the amount of resolution as defined in claim 4, further comprising the step of amplifying the desired radio channel in the radio frequency domain, and

adjusting the gain of said radio frequency amplification step if the output of the ADC over time indicates that an adjustment in the RF gain will provide for reduction in the value of ADC_N.

11. A method for determining the amount of resolution as defined in claim 7, further comprising the step of amplifying the desired radio channel in the radio frequency domain, and

adjusting the gain of said radio frequency amplification step if the output of the ADC over time indicates that an adjustment in the RF gain will provide for reduction in the value of ADC_N.

12. A method for determining the amount of resolution as defined in claim 7, further comprising the step of amplifying the desired radio channel at an intermediate frequency, and

adjusting the gain of said radio frequency amplification step if the output of the ADC over time indicates that an adjustment in the intermediate frequency gain will provide for reduction in the value of ADC_N.

13. A method for determining the amount of resolution as defined in claim 1, further comprises the step of determining if the radio channel signal level is changing faster than a predetermined amount over a period of time and if true, generating an alert signal (ALERT_N) and adjusting ADC_N as a function of the previous value of ADC_N and ALERT_N.

14. A method of determining the amount of resolution as defined in claim 13, wherein the alert signal adjusts the execution speed of steps 4 and 5 so as to reduce latency in the determination of the amount of resolution.

15. A method for determining the amount of resolution as defined in claim 2, further comprises the step of determining if the radio channel signal level is changing faster than a predetermined amount over a period of time and if true, reducing the latency in the determination of the amount of resolution by immediately adjusting the resolution of ADC in a predetermined manner.

16. A method for determining the amount of resolution as defined in claim 4, further comprises the step of determining if the radio channel signal level is changing faster than a predetermined amount over a period of time and if true, reducing the latency in the determination of the amount of resolution by immediately adjusting the resolution of ADC in a predetermined manner.

17. A method for determining the amount of resolution as defined in claim 16, wherein an alert signal (ALERT_N) is generated if the radio channel signal level is changing faster than a predetermined amount over a period of time, and wherein the alert signal is used to redetermine the gain for the ADC.

18. A method for determining the amount of resolution (ADC_N) required for converting a received desired radio channel from the analog domain to the digital domain (A/D conversion), comprising the steps of:

1) obtaining a target resolution (TARGET_N) for converting the received radio channel from the analog domain to the digital domain assuming that potentially interfering radio channels are filtered out;
2) measuring the received signal strength (RSSI) of the radio channel;
3) determining the amount of resolution (ADC_N) based upon the full-scale resolution (ADC_FULL) of an analog-to-digital converter used for the A/D conversion, the target resolution and the received signal strength;
4) remeasuring RSSI;
5) checking if the new RSSI value is within certain limits specified for that measurement; and
6) if step 5 is true, repeating steps 4 and 5; otherwise repeating steps 3, 4 and 5.

19. A method for determining the amount of resolution as defined in claim 18, wherein step 3 is defined by:

ADC_N = ADC_FULL - RSSI + TARGET_N.

20. A method for determining the amount of resolution (ADC_N) required for decoding a desired radio channel, comprising the steps of:

1) obtaining a target resolution (TARGET_N) for decoding the desired radio channel assuming that potentially interfering radio channels are filtered out;
2) measuring the received signal strength (RSSI) of the radio channel;
3) determining the amount of resolution (ADC_N) based upon the full-scale resolution (ADC_FULL) of an analog-to-digital converter, the target resolution and the received signal strength;
4) remeasuring RSSI; and
5) repeating steps 3 and 4.

21. A method for determining the amount of resolution as defined in claim 20, wherein step 3 is defined by:

ADC_N = ADC_FULL - RSSI + TARGET_N.

22. A method for determining the amount of resolution as defined in claim 21, further comprising the step of:

determining the gain (Apre_Av) that will provide a desired input level for the desired radio channel to be presented to the ADC.

23. A method for determining the amount of resolution as defined in claim 22, further comprising the steps of:

measuring the signal level (ADC_OUT) at the output of the ADC;
and adjusting the value of the gain (Apre_Av)
if

a) ADC_OUT < ADC_HIGH is false or, if true, if
b) ADC_OUT > ADC_LOW is false;

where ADC_HIGH and ADC_LOW are the upper and lower signal threshold levels at the input of the ADC, respectively, that will indicate the need to change gain.

24. A method for determining the amount of resolution as defined in claim 22, further comprising the steps of:

measuring the signal level (ADC_OUT) at the output of the ADC;

determining a fading margin (FADE_M) associated with the mode of operation of the desired radio channel; and

adjusting the value of the gain (Apre_Av)

if

a) ADC_OUT < ADC_FULL - FADE_M is false or, if true, if

b) ADC_OUT > ADC_FULL - FADE_M - 2 * Apre_step is false;

where Apre_step is the gain step of an amplifier that is used to provide the gain (Apre_Av) to the radio channel prior to analog-to-digital conversion.

25. A method for determining the amount of resolution as defined in claim 24, wherein the gain adjustment if substep a) is true and substep b) is false is:

Apre_Av(n) = Apre_Av(n-1) - Apre_step,

and wherein the gain adjustment if substeps a) and b) are true and substep c) is false is:

Apre_Av(n) = Apre_Av(n-1) + Apre_step;

where n is the sequence samples in time.

26. A method for determining the amount of resolution as defined in claim 20, wherein the step of measuring received signal strength (RSSI) is based upon an average value of the received signal strength.

27. A method for determining the amount of resolution as defined in claim 22, further comprising the step of amplifying the desired radio channel in the radio frequency domain, and

adjusting the gain of said radio frequency amplification step if the output of the ADC over time indicates that an adjustment in the RF gain will provide for reduction in the value of ADC_N.

28. A method for determining the amount of resolution as defined in claim 25, further comprising the step of amplifying the desired radio channel in the radio frequency domain, and

adjusting the gain of said radio frequency amplification step if the output of the ADC over time indicates that an adjustment in the RF gain will provide for reduction in the value of ADC_N.

29. A method for determining the amount of resolution as defined in claim 25, further comprising the step of amplifying the desired radio channel at an intermediate frequency, and

adjusting the gain of said radio frequency amplification step if the output of the ADC over time indicates that an adjustment in the intermediate frequency gain will provide for reduction in the value of ADC_N.

30. A method for determining the amount of resolution as defined in claim 20, further comprises the step of determining if the radio channel signal level is changing faster than a predetermined amount over a period of time and if true, generating an alert signal (ALERT_N) and adjusting ADC_N as a function of the previous value of ADC_N and ALERT_N.

31. A method of determining the amount of resolution as defined in claim 30, wherein the alert signal adjusts the execution speed of steps 3 and 4 so as to reduce latency in the determination of the amount of resolution.

32. A method for determining the amount of resolution as defined in claim 20, further comprises the step of determining if the radio channel signal level is changing faster than a predetermined amount over a period of time and if

true, reducing the latency in the determination of the amount of resolution by immediately adjusting the resolution of ADC in a predetermined manner.

33. A method for determining the amount of resolution as defined in claim 32, wherein an alert signal (ALERT_N) is generated if the radio channel signal level is changing faster than a predetermined amount over a period of time, and wherein the alert signal is used to redetermine the gain for the ADC.

34. An apparatus for determining the amount of resolution (ADC_N) required for decoding a desired radio channel, comprising:

A) an analog-to-digital converter (ADC) having a full-scale resolution (ADC_FULL), the ADC operable at a resolution (ADC_N) that can be less than the full-scale resolution (ADC_FULL), the ADC converting an analog input signal received at an input into a digitized radio channel;

B) a power detector having an input in communication with the digital output of the analog-to-digital converter so as to measure the received signal strength (RSSI) of the radio channel;

C) control logic that has an input in communication with the output of the power detector so as to determine the amount of resolution (ADC_N) based upon the full-scale resolution (ADC_FULL) of the analog-to-digital converter, a target resolution (TARGET_N) and the received signal strength, where the target resolution is the resolution necessary to decode the desired radio channel assuming that potentially interfering radio channels are filtered out; and

D) means for communicating the determined amount of resolution (ADC_N) to the analog-to-digital converter so that the ADC operates at said resolution.

35. An apparatus as defined in claim 34, wherein the control logic has means for repetitively determining the amount of resolution (ADC_N).

36. An apparatus as defined in claim 35, wherein the control logic determines the amount of resolution with the relationship:

$$ADC\_N = ADC\_FULL - RSSI + TARGET\_N.$$

37. An apparatus as defined in claim 36, further having means for causing the control logic to repetitively determine the amount of resolution (ADC_N) if the received signal strength (RSSI) is outside of limits specified for the measurement of RSSI.

38. An apparatus as defined in claim 37, further comprising a first amplifier to amplify the signal prior to presenting the signal to the ADC, wherein the control logic has means for adjusting the gain of the first amplifier responsive to the digital output of the ADC.

39. An apparatus as defined in claim 38, wherein a second power detector measures the value of the digital output of the analog-to-digital converter by determining the digital output resolution of the analog-to-digital converter (ADC_OUT).

40. An apparatus as defined in claim 39, further comprising an RF amplifier for amplifying the radio channel while in the radio frequency domain, and further comprising:

an additional power detector to measure the output power of the RF amplifier; and

wherein the control logic has means for repetitively determining the gain of the RF amplifier based upon the output of the additional power detector.

41. An apparatus as defined in claim 40, wherein the control logic further has means for determining if the radio channel signal level is changing faster than a predetermined amount over a period of time so as to reduce the latency of the repetitive determination of the amount of resolution (ADC_N) if said condition is true.

42. A radio receiver having adjustable dynamic range, comprising:

an antenna;

means for amplifying a desired radio channel;

an analog-to-digital converter (ADC) having a full-scale resolution (ADC_FULL), the ADC operable at a resolution (ADC_N) that can be less than the full-scale resolution (ADC_FULL), the ADC for converting the desired radio channel to a digital signal; and

means for decoding the digital signal to obtain the desired radio channel;

wherein the radio receiver further comprises:

a power detector having an input in communication with the digital output of the analog-to-digital converter so as to measure the received signal strength (RSSI) of the radio channel;

control logic that has an input in communication with the output of the power detector so as to determine the amount of resolution (ADC_N) based upon the full-scale resolution (ADC_FULL) of the analog-to-digital converter, a target resolution (TARGET_N) and the received signal strength, where the target resolution is the resolution necessary to decode the desired radio channel assuming that potentially interfering radio channels are filtered out; and

means for communicating the determined amount of resolution (ADC_N) to the analog-to-digital converter so that the ADC operates at said resolution.

43. A radio receiver having adjustable dynamic range as defined in claim 42, wherein the control logic has means for repetitively determining the amount of resolution (ADC_N).

44. A radio receiver having adjustable dynamic range as defined in claim 43, wherein the control logic determines the amount of resolution (ADC_N) with the relationship:

$$ADC\_N = ADC\_FULL - RSSI + TARGET\_N.$$

45. A radio receiver having adjustable dynamic range as defined in claim 44, further having means for causing the control logic to repetitively determine the amount of resolution (ADC_N) if the received signal strength (RSSI) is outside of limits specified for the measurement of RSSI.

46. A radio receiver having adjustable dynamic range as defined in claim 45, further comprising a first amplifier to amplify the signal prior to presenting the signal to the ADC, wherein the control logic has means for adjusting the gain of the first amplifier responsive to the digital output of the analog-to-digital converter.

47. A radio receiver having adjustable dynamic range as defined in claim 46, further comprising an RF amplifier for amplifying the radio channel while in the radio frequency domain, and further comprising:

an additional power detector to measure the output power of the RF amplifier; and

wherein the control logic has means for repetitively determining the gain of the RF amplifier based upon the output of the additional power detector.

48. A radio receiver having adjustable dynamic range as defined in claim 42, wherein the control logic further has means for determining if the radio channel signal level is changing faster than a predetermined amount over a period of time so as to reduce the latency of the repetitive determination of the amount of resolution (ADC_N) if said condition is true.